

ROYAL ASTRONOMICAL SOCIETY.

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No. 3.

CAPTAIN W. H. SMYTH, R.N., President, in the Chair.

The following gentlemen were balloted for, and duly elected Fellows of the Society :—

The Rev. George Yatman Boddy, M.A., of the Royal Military Academy, Woolwich; the Rev. William Slatter, of Rose Hill, near Oxford; and John Drew, Esq., of Winsor House, Cumberland Place, Southampton.

The following communications were read :—

I. Announcements of the Discovery of the new Planet *Astræa*; with Observations, Elements, &c.

The addition of a new planet to the solar system is a fact so interesting and important in astronomy, as to require that the numerous communications of which it has already been the subject should be treated and discussed in the publications of this Society with a greater regard to classification and arrangement than is necessary, or indeed always practicable, in other cases of less prominent interest. Instead, therefore, of giving an abstract of each separate communication that has been received respecting the new planet *Astræa*, it is proposed to give, first, a brief historical notice of its discovery, and of the manner in which the search after it was prosecuted; secondly, a tabular statement of the observations of the planet which have been received; and, thirdly, the elements which have been computed. With regard to its history, the first fact that occurs to us, as equally creditable to its discoverer and instructive to amateur astronomers and others who are desirous to extend the bounds of astronomical science, is, that its discovery was by no means accidental, but the reward of long and well-directed search. Perhaps many persons are apt, on occasions like the present, to regard the discovery of any new body in our system as a lucky accident, resulting from a casual or careless sweep among the stars, though the fact with regard to the greater number of such discoveries is directly the opposite of this. The four asteroids which have been for years recognised as belonging to our system, were the reward of three or four successive steps of true philosophical inquiry. An obvious analogy existed in the distances of the primary planets from the sun, which, though not the result of any known law of nature, was yet sufficiently evident in fact to draw the attention of astronomers to its equally remarkable failure at one particular distance, viz. that at which those bodies were afterwards discovered. It was at least worthy of an attempt at its verification;

and such was accordingly instituted by several astronomers. Lambert appears first to have suggested the idea of the existence of a yet undiscovered body, and Bode's celebrated empirical law was published by him in 1772; but no serious attempt by means of co-operation was made to effect its discovery till the autumn of the year 1800, when an Association of twenty-four astronomers was formed, having Schröter for their president and Zach for secretary, who engaged to observe thoroughly every star visible within the zodiacal limits. The announcement of the discovery of *Ceres* by Piazzi, on Jan. 1, 1801, was made to Lalande, Bode, and Oriani on the 24th of January following, very soon after the formation of this Association,* and its planetary nature was soon recognised. This discovery was speedily followed by that of *Juno* by Harding, and of *Pallas* and *Vesta* by Olbers.† The last planet, it is well known, was discovered through a search suggested by the curious yet natural hypothesis of the bodies being fragments of a large planet which had been shattered into fragments. *Uranus* also, to use Sir John Herschel's own words, "was discovered by Sir W. Herschel, in the course of a review of the heavens, in which every star visible in a telescope of a certain power was brought under close examination, when the new planet was immediately detected by its disc, under a high magnifying power."

Such, briefly, is the well-known history of the discovery of those planets of our system which required the aid of optical resources and of persevering search among the stars for the detection of their existence; and it is interesting to find that we are indebted for our knowledge of *Astræa* to a similar sagacity and perseverance. The discoverer, M. Hencke, of Driessen, in Prussia, is a gentleman who, at one period of his life, was employed in the post-office of that town, but who, being gifted with a taste for astronomical pursuits, has, for the last fifteen years, been rendering himself familiar with the general features of the heavens, for the express purpose of discovering such a body as has now rewarded his exertions. The circumstances which attended the discovery of the other four asteroids rendered it, antecedently, extremely probable that others yet remained to be detected; and the difficulty lay in conducting a search of such a nature. The body to be discovered would be probably of a brightness equivalent to a star of from the 8th to the 10th magnitude, and the only sensible circumstance in which it would differ from a star would be its motion. But the motion of a body can be detected only by comparisons between its situations on different days; and there would be nothing to direct the choice of the objects to be tried amongst the hundreds that one sweep of the telescope would present to the observer. Nothing, then, it is evident, but a complete familiarity with the part of the heavens under review, and a knowledge of the relative positions of all the stars in it, to the limits of the lowest magnitude above

* It is a singular fact that Piazzi was not a member of this Association, and that, in spite of such an organisation, the discovery was, in fact, accidental.

† *Pallas* was discovered in 1802; *Juno* in 1804; and *Vesta* in 1807.

specified, would suffice to assure the observer of the presence of an object in a particular position on one evening which did not occupy that position on a preceding. M. Hencke, while examining a portion of the heavens in the fourth hour of R. A., on December 8, was immediately aware of the presence, directly between two stars of the 9·10th magnitude, marked on the Berlin maps, and denoted by the positions

R. A.....	4 ^h 18 ^m 45 ^s }
N. P. D.....	77° 18' 1" }
And R. A.	4 ^h 20 ^m 20 ^s }
N. P. D.....	77° 28' 9" }

of a star of the 9th magnitude, not marked on the maps; and, from his familiarity with this part of the heavens, he felt assured that the star did not previously exist there. He wrote immediately to Professor Encke, and soon afterwards to Professor Schumacher (the letter to Schumacher was received by him December 13), announcing his suspicions of the discovery of a new planet, and giving the position of the star in question for the time of his observation, viz.—

Dec. 8, 8^h Berlin Mean Time.

R. A.	= 65° 25'
N. P. D.....	= 77 19

Professor Encke and Professor Schumacher immediately made public M. Hencke's communication; and we are indebted to them for the principal sources of our information relating to the discovery, by letters to the Astronomer Royal and Mr. Hind, dated respectively December 15 and December 16. It is well known with what interest the intimations of the discovery were received in England, and the personal zeal of the Astronomer Royal in immediately circulating the notice which he had received by every possible means, needs no comment.

The results of the search after the planet, which has been instituted by every astronomer with great readiness, will be best given by exhibiting, in a tabular form and in chronological order, the observations which have been made of it, and the elements and ephemerides which have been computed.

The foreign communications which have been received are,—

1. Four from Professor Schumacher to Mr. Hind, dated 1845, December 16, 23, 25, and 30; that on December 25 being a printed circular.

2. One from Professor Encke to the Astronomer Royal, dated 1845, December 23, and extensively circulated.

3. Two from Mr. Rumker to Dr. Lee, dated December 19 and 30.

But, since the meeting of the Society, a circular has been received from Professor Schumacher, which contains a list of all the places deduced from the foreign observations previously received, compiled by M. d'Arrest, and a comparison by that gentleman of the observed places and those computed from elements by Professor

Encke, based on the Berlin observations of December 14, 21, and 27. It will, therefore, be desirable to give the results of this circular, without farther reference to the observations contained in the previously received communications.

Encke's elements are,—

Epoch of Mean Longitude, 1846, January 0, 0^h, Berlin Mean Time
94° 48' 11.8"
Mean anomaly 319 2 54.8
Long. of the Perihelion .. 135 45 17.0 } Mean Equinox,
Longitude of the Node... 141 10 6.7 } 1846, Jan. 0.
Inclination 5 20 7.2
Angle of Eccentricity.... 11 16 30.4 e = 0.195520
Log. semi-axis major.... 0.413564
Mean daily motion..... 850.473
Time of revolution, 1524 days.

Comparison of the Observations.

Date.	Mean Time of Observation.	Place of Observation.	Right Ascension.	Declination.	Computed — Observed.	
1845. Dec. 14	^h ^m ^s 13 56 59.7	Berlin	64° 0' 36.0	+ 12° 39' 49.6	— 4.4	— 2.1
15	7 12 9.3	.....	63 50 54.1	12 40 0.5	+ 7.2	— 14.1
16	10 20 16.5	.....	63 36 5.6	12 39 57.1	+ 2.1	— 4.4
17	8 40 22.0	Hamburg	63 24 5.2	.....	+ 0.2	...
	8 50 49.6	.....	....	12 40 7.4	...	— 2.3
	9 44 23.1	Altona	63 23 33.7	12 40 6.5	— 3.2	— 0.8
	9 44 23.1	.....	63 23 25.4	12 40 15.1	+ 5.1	— 9.4
	10 28 2.1	Hamburg	63 23 9.7	12 40 18.7	— 2.8	— 12.3
	10 28 2.4	Altona	63 23 8.3	12 40 22.4	— 1.5	— 16.0
20	7 38 51.4	Berlin	62 48 6.4	12 41 31.5	— 2.4	— 1.3
21	7 49 38.4	.....	62 36 27.0	12 42 16.9	— 2.3	— 1.5
24	6 3 59.5	Hamburg	62 4 39.1	12 44 53.7	— 0.6	+ 20.0
	6 29 13.4	Altona	62 4 25.2	12 45 18.0	+ 2.2	— 2.8
27	7 48 9.5	Hamburg	61 35 17.8	.....	— 14.0	...
	8 27 41.5	.....	.....	12 49 50.8	...	— 11.5
	8 30 6.8	Altona	61 34 50.9	12 50	— 3.3	...
	11 13 39.2	Berlin	61 33 48.5	12 50 12.8	+ 0.3	— 23.1
	11 29 14.6	.....	61 33 46.4	12 49 51.8	— 3.1	— 1.0
28	8 28 0.6	Hamburg	61 26 11.7	.....	— 7.3	...
	8 32 33.3	.....	.....	12 51 29.1	...	— 6.9
	9 37 16.0	.....	61 25 36.6	12 51 30.5	+ 2.4	— 3.7
31	8 0 18.9	Berlin	61 2 57.3	12 57 17.3	— 7.3	— 3.9
	9 23 41.7		61 2 33.8	12 57 23.6	— 10.9	— 2.7
	7 20 59.3	Altona	61 3 2.8	12 57 16.9	— 10.0	— 0.7
	8 21 23.1		60 49 28.2	+ 13 2 1.7	— 10.5	— 3.4

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Time by Clock.			Astræa North of B.A.C. 1275.	
h	m	s		
At 2	21	25.5		20.8
	2	43	56.5	24.7
At 2	32	41.0		
Clock slow		2	59.5	
At 2	35	40.5	Green. Sid. Time, Astræa 22.8 North of B.A.C. 1275.	
			Apparent place of B.A.C. 1275 is 4 ^h 0 ^m 27 ^s .5, N.P.D. 77° 0' 46".7.	

II. Tycho's Observations of the Comet of 1596, copied from the original Manuscripts of the Observatory of Uraniburg. By Professor Schumacher.

III. Elements of the Orbit of the Great Comet of 1844-5. By J. R. Hind, Esq.

These elements were computed without making any assumption respecting the conic section described, from the observations of 1845, January 10, February 7, and March 11; made by Mr. Caldecott, Dr. Peters, and Professor Challis respectively. The result is the following hyperbolic orbit.

Perihelion Passage, 1844, December 13.43188, Greenwich Mean Time.

Long. of Perihelion on Orbit ...	303° 58' 15".12	} Mean Equinox, 1845°.0.
Long. of Ascending Node.....	114 59 7.27	
Inclination	46 49 2.96	
$\psi = \sec^{-1}e = 24^{\circ} 47' 33''.25$ $e = 1.1015256$.		
Log. perihelion distance 9.5065345.		
Motion direct.		

For the middle observation, the error in longitude is + 6".25, and in latitude — 0".84.

IV. Sextant Observations of the Distance of the Great Comet of 1844-5 from bright Stars, made at sea on board the brig *Anonyma*. By Captain C. R. D. Bethune, R.N.

1844, Dec. 29. Lat. 16° 10' N.; Long. 73° 5' E. The comet was first seen just before setting. Its nucleus was distinct, and equal to a star of the 4th or 5th magnitude; the estimated length of its tail was 5° or 6°, extending between α and γ *Gruis*.

Dec. 30. Lat. 14° 22' N.; Long. 74° 18' E. The comet was perceived nearly an hour after sunset, and the following observations were made with an 8-inch sextant; telescope inverting; index error + 7' 10".

Barometer 30ⁱⁿ.00; Thermometer 80° Fahr.

Chronometer Time.

h	m	s	Distance from α Pisc. Aust.	28° 32' 0"
1	52	13	...	α Eridani ... 44 40 30
1	56	32	...	α Pisc. Aust. 26 31 30
2	0	20	...	α Eridani ... 44 38 30
2	4	59	..	

Distance between the two stars observed, 39° 0' 0".